

WHAT IS CLAIMED IS:

1. A start control apparatus of an internal combustion engine, comprising:

5 a starter driven when the internal combustion engine is started,

a starter detection unit for detecting switching between drive and non-drive of the starter,

10 a number-of-revolution detection unit for detecting the number of revolutions of the internal combustion engine,

a crankshaft being connected to the internal combustion engine for rotating,

15 a crank angle sensor for rotating in synchronization with the crankshaft and outputting a crank angle signal every predetermined angle and also having a reference position signal for indicating a reference angle in the crank angle signal,

a cam shaft for rotating in a predetermined ratio to rotation of the crankshaft,

20 a cam sensor for rotating in synchronization with the cam shaft and outputting a predetermined pattern signal for making a cylinder determination, and

a control unit for performing ignition control of the internal combustion engine based on the output signals of both the crank angle sensor and the cam sensor, wherein

25 the control unit has a start determination unit for

determining whether starting the internal combustion engine is to be stopped or continued based on the crank angle and the number of revolutions just before the crank angle just after the starter detection unit detects the starter being switched
5 from a drive state to a non-drive state when the detected number of revolutions is less than idling speed, and performs ignition stop control to stop starting the internal combustion engine or performs ignition control to continue starting the internal combustion engine in accordance with the start determination
10 result.

2. The start control apparatus of the internal combustion engine according to claim 1, wherein

when the number of revolutions of the internal combustion
15 engine just before the starter being switched from the drive state to the non-drive state is detected rises to equal to or greater than a predetermined value, the start determination unit determines that starting the internal combustion engine is to be continued and if the number of revolutions is less
20 than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be stopped.

3. The start control apparatus of the internal
25 combustion engine according to claim 1, wherein

when the maximum number of revolutions among the stored numbers of revolutions of the internal combustion engine just before the starter being switched from the drive state to the non-drive state is detected is equal to or greater than a predetermined value exceeding the number of revolutions at which driving by the starter is possible, the start determination unit determines that starting the internal combustion engine is to be continued and if the number of revolutions is less than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be stopped.

4. The start control apparatus of the internal combustion engine according to claim 1, wherein

when the minimum number of revolutions among the stored numbers of revolutions of the internal combustion engine just before the starter being switched from the drive state to the non-drive state is detected is equal to or greater than a predetermined value exceeding the number of revolutions at which driving by the starter is possible, the start determination unit determines that starting the internal combustion engine is to be continued and if the number of revolutions is less than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be stopped.

5. The start control apparatus of the internal combustion engine according to claim 3, further comprising a temperature sensor for detecting temperature in the internal combustion engine, wherein

when the temperature is a high temperature equal to or greater than a predetermined value, the start determination unit uses the maximum number of revolutions among the stored numbers of revolutions of the internal combustion engine just before the starter being switched from the drive state to the non-drive state is detected or if the temperature is less than the predetermined value, the start determination unit uses the minimum number of revolutions, and makes a comparison between the predetermined value exceeding the number of revolutions at which driving by the starter is possible and the maximum or minimum number of revolutions and if the maximum or minimum number of revolutions is equal to or greater than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be continued and if the maximum or minimum number of revolutions is less than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be stopped.

6. The start control apparatus of the internal

combustion engine according to claim 1, wherein

when the crank angle when the starter being switched from the drive state to the non-drive state is detected is just after ignition, the start determination unit postpones determination
5 until a predetermined crank angle is detected and if the number of revolutions of the internal combustion engine rises to equal to or greater than a predetermined value after the predetermined crank angle is detected, the start determination unit determines that starting the internal combustion engine is to be continued
10 and if the number of revolutions is less than the predetermined value, the start determination unit determines that starting the internal combustion engine is to be stopped.

7. The start control apparatus of the internal
15 combustion engine according to claim 1, wherein

when the starter being switched from the drive state to the non-drive state is detected, if ignition energization control is being performed for the internal combustion engine, if the number of revolutions of the internal combustion engine
20 rises to equal to or greater than a predetermined value, the start determination unit determines that starting the internal combustion engine is to be continued and if the number of revolutions is less than the predetermined value, the start determination unit determines that starting the internal
25 combustion engine is to be stopped, and ignition energization

is extended until a predetermined crank angle is reached or until a predetermined time has elapsed.